

# *Paryphantopsis* (Gastropoda: Pulmonata: Charopidae) from the Louisiade Archipelago of New Guinea

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## ABSTRACT

Recent surveys (2003–2004) of the terrestrial snail fauna of the three largest islands in the Louisiade Archipelago, Misima, Rossel and Sudest have uncovered a remarkable radiation of *Paryphantopsis*, a diverse genus of charopid snails endemic to New Guinea and nearby islands. Previously, only one species, *Paryphantopsis louisadarum*, here recognized as endemic to Rossel Island, was known from the Louisiade Archipelago. Three additional species were uncovered, all new and all appear to be endemic to single islands within the Louisiade Archipelago. The four species are described or redescribed using information on shell, genital and radular anatomy. The terrestrial mollusks of many of the other islands in the Louisiade Archipelago have never been sampled and it is likely that diversity of *Paryphantopsis* and other land snails is underestimated in the Louisiades.

*Additional Keywords:* Mollusca, mollusks, terrestrial, gastropods, land snails, endemism, Papua New Guinea.

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## INTRODUCTION

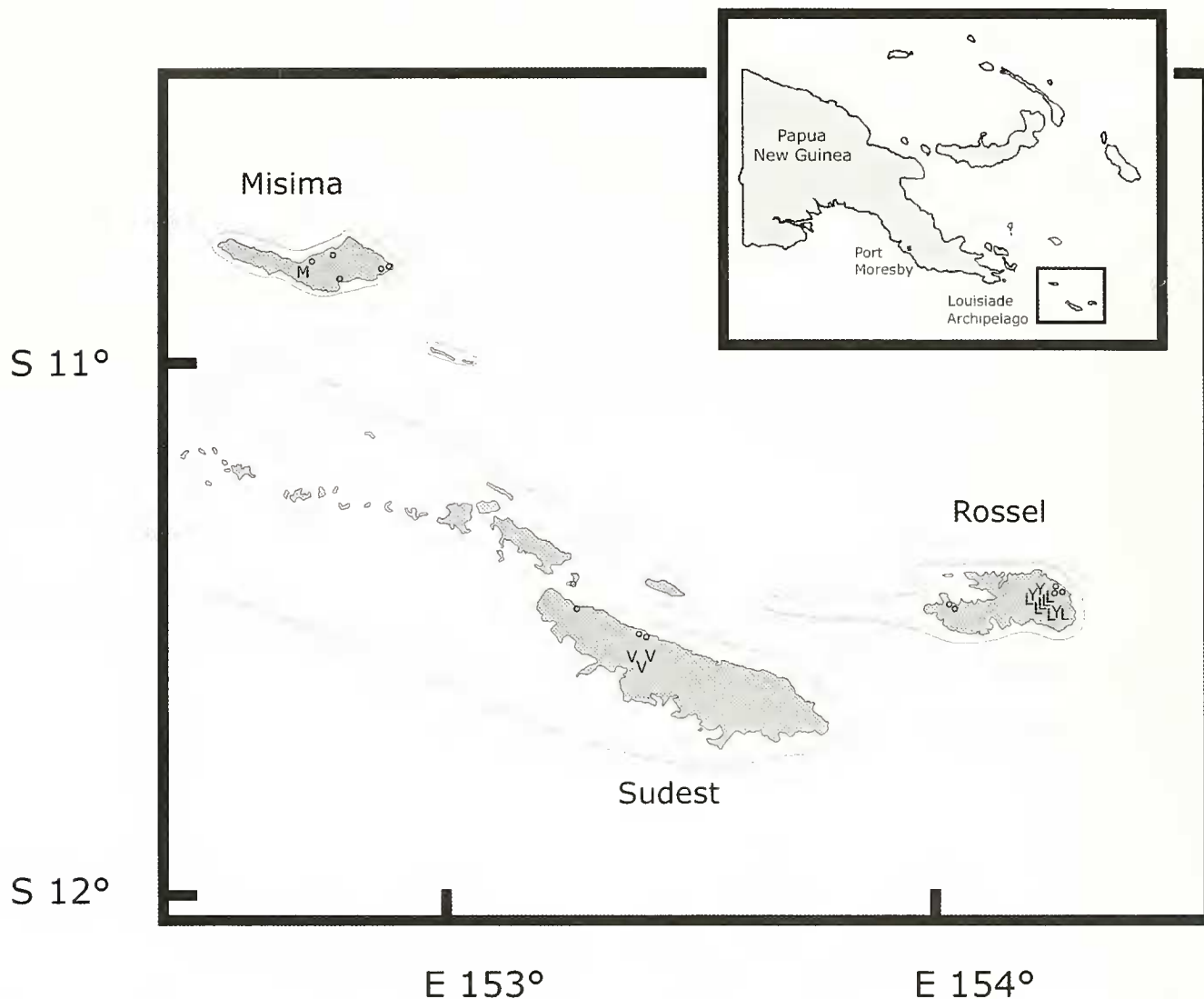
This is the second in a series of reports on the results of recent field surveys of terrestrial mollusks from Papua New Guinea. The first report (Slapcinsky, 2005) described six new species of the charopid genus *Paryphantopsis* from the eastern peninsula of mainland New Guinea; this, the second, reviews *Paryphantopsis* species collected during ten weeks of field surveys in January 2003 and April–May 2004 from the three largest islands in the Louisiade Archipelago: Misima (St. Aignian), Rossel (Yela), and Sudest (Vanatinai, Tagina). *Paryphantopsis*, a genus of charopid snails endemic to New Guinea, is comprised of twenty described species (Solem, 1970; Slapcinsky, 2005) that are distributed from Western Papua (Irian Jaya) to the Louisiade Archipelago. Only one species, *Paryphantopsis louisadarum* (Möllendorff, 1899) was previously known from the Louisiade Archipelago; it is the type of the genus *Illocesta* (Iredale, 1941), later synonymized with *Paryphantopsis* (Solem, 1955).

The Louisiade Archipelago, a group of volcanic islands

and coral islets, with a total area of approximately 1600 km<sup>2</sup>, lies about 300 km east of the New Guinea mainland and 400 km west of the Solomon Islands (Figure 1). The archipelago is located on the southeastern extension of the Owen Stanley Terrane, part of the East Papua Composite Terrane (EPCT), a tectonic province composed of at least four separate geological units with differing ages, origins, and histories that appear to have assembled northeast of modern New Guinea during the Paleocene, 62–57 Myr ago, and fused to the main body of the island in the Late Oligocene to Early Miocene, 28–22 Myr ago. The Louisiades are at least 15–20 million years old and more likely were formed 40–60 million years ago and have apparently never had a land connection with the New Guinea mainland (Pigram and Davies, 1987). The Louisiades physical isolation and great age combine to provide considerable opportunity for the evolution of a distinctive fauna. However, this fauna is poorly sampled, especially for invertebrates, including terrestrial mollusks. Only approximately 30 species of land-snails are known from the archipelago (Iredale, 1941), these were collected during brief surveys in the mid to late 19<sup>th</sup> Century. Nearly all of these species appear to be restricted to single islands. Low sampling intensity combined with anticipated high levels of endemism suggests that land snail diversity in the archipelago is under-sampled.

## MATERIALS AND METHODS

Specimens were hand-collected, drowned overnight, and preserved in 75% ethanol. Gross anatomical dissections were made in 75% ethanol using a dissecting microscope. Radulae were isolated from dissected buccal masses using a saturated KOH solution. Scanning electron micrographs of radulae were made using a Field Emission-SEM. Line drawings of the genital anatomy were made from digital images, and measurements were taken using an ocular micrometer. Shell and radular measurements were made as figured in Slapcinsky (2005). Whorl count was measured from the suture of the first whorl to the body whorl and fractions of a whorl were determined



**Figure 1.** Distribution of *Paryphantopsis* in the Louisiade Archipelago, Papua New Guinea; L = *P. louisiodarum*, M = *P. misimensis*, V = *P. vanatinensis*, Y = *P. yelensis*, o = other sites sampled.

with the aid of a cardboard circle divided into ten equal parts of 36°. Spire diameter was the length of a straight line passing from the apertural edge of the suture through the middle of the apex to the opposite suture. Diameter was the greatest width of the shell perpendicular to the shell axis. Height was the greatest distance between the apex and the base of the aperture measured parallel to the shell axis. Spire height was measured from the top of the body whorl to the apex of the shell. Aperture width was the greatest distance from the columellar edge to the outer edge of the aperture. Aperture height was measured from the suture to the base of the aperture, parallel to the shell axis. The following abbreviations are used in figures of genital anatomy: AT = atrium; DI = diverticulum; EP = epiphallus; OV = free oviduct; PE = penis; PG = prostate gland; PP = penial pilasters; PR = penial retractor muscle; SD = spermathecal duct; SP = spermatheca; VA = vagina; and VD =

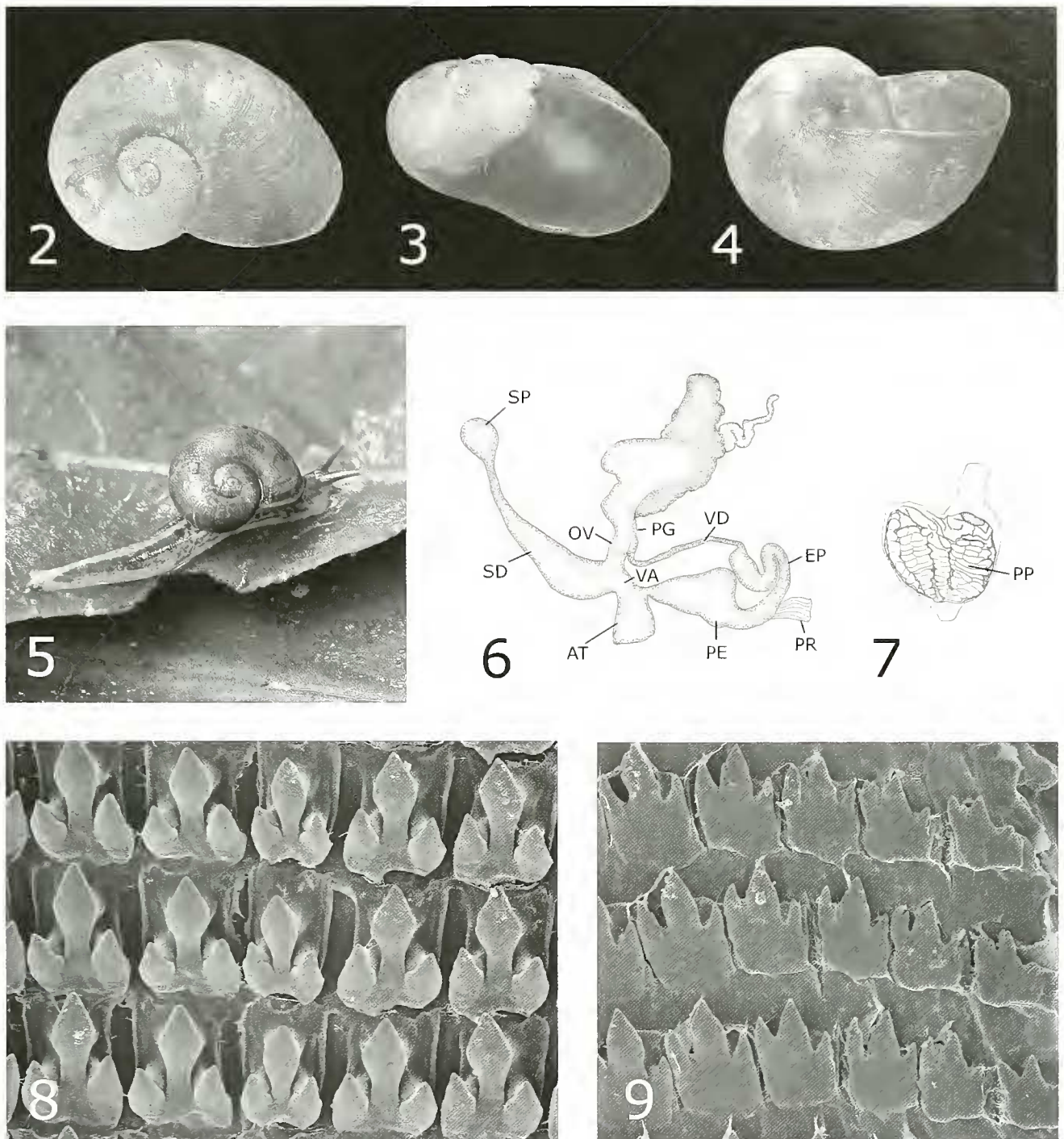
vas deferens. Terminology of vegetation types follows Paijmans (1976). Specimens are deposited in the following institutions: Bernice P. Bishop Museum, Honolulu (BPBM); Florida Museum of Natural History, Gainesville (UF); Natur-Museum Senckenberg, Frankfurt (SMF); Papua New Guinea National Museum, Port Moresby (PNGNM); Wrocław University Museum of Natural History (MNHW); Queensland Museum (QM).

#### SYSTEMATICS

Family Charopidae Hutton, 1884  
Genus *Paryphantopsis* Thiele, 1928

**Type species:** *Flammulina (Paryphantopsis) lamelligera* Thiele, 1928, by original designation.

*Paryphantopsis louisiodarum* (Möllendorff, 1899)  
(Figures 2–9, Table 1)



Figures 2–9. *Paryphantopsis louisadarum*. 2–4. Photographs of shell, UF 353425, diameter 10.6 mm. 5. Photograph of live animal. 6–7. Camera lucida drawing of genitalia, UF 353426, maximum width 11.6 mm. 8–9. Scanning electron micrograph of radula, UF 353426, field width of central and lateral teeth 61  $\mu\text{m}$ , marginals 70  $\mu\text{m}$ .

*Paryphanta louisadarum* Möllendorff, 1899: S9; Möllendorff and Kobelt, 1902–1903: 17, pl. 3, figs. 1–3.

*Illonesta louisadarum* (Möllendorff, 1899).—Iredale, 1941: 92–93.

*Paryphantopsis louisadarum* (Möllendorff, 1899).—Solem, 1955: 23; Solem, 1959: 156, pl. 12, figs. 10–11, pl. 13, fig. 6; Solem, 1970: 259–260.

**Description:** The adult shell is depressed globose and large for the genus, 9.3–11.9 mm (mean = 10.3, see Table I for sample size and standard deviation) in diameter and 6.7–9.0 mm (mean = 7.5) in height, with 2.7–3.0 (mean = 2.8) rapidly expanding whorls (Figures 2–4). The sutures are deeply impressed and the shell margin is

evenly rounded. The spire is flat to slightly elevated 0.0–0.2 mm (mean = 0.1). The body whorl descends slowly near the aperture and the shell height/diameter ratio is 0.66–0.80 (mean = 0.73). The shell has 1.3 evenly rounded protoconch (nuclear) whorls, sculptured with spiral rows of small pits, approximately 15 rows can be seen on the apex of adult shells. These spiral pits continue on the teleoconch (post-nuclear) whorls eventually merging into incised spiral striae that weaken towards the aperture. The teleoconch whorls are also sculptured with weak growth lines that are not accentuated by periostracal extensions; these are strongest on the body whorl near the aperture. The protoconch and teleoconch whorls are brown. The suture is darker brown and the body whorl is usually irregularly maculated with darker brown. The umbilicus is closed by a reflection of the peristome. The aperture is large, compressed ovate, with an aperture-width to aperture-height ratio of 0.91–0.98 (mean = 0.95).

The body color is bright yellow with green-black pigment on the head and eyestalks extending in two lateral bands to the posterior of the foot (Figure 5). These bands are irregularly maculate anteriorly and extend ventrally, often visible as spots on the sole of the foot. The yellow fades to creamy-white in specimens preserved in ethanol. The vas deferens remains narrow to the slightly swollen head of the epiphallus (Figure 6). The epiphallus does not bear a diverticulum. The penis is 0.70 the length of the epiphallus and is apically robust, about 3 times the width of the epiphallus at their junction, and tapers rapidly towards its base. Penis is sculptured with four pilasters two of these are wide and two narrower. Each pilaster is regularly plicated perpendicular to the length of the penis (Figure 7). The penial retractor muscle originates from the diaphragm and inserts on the basal 0.30 of the epiphallus. The spermathecal duct is robust, narrowing gradually from the basal 0.25 to the apical 0.25 and remaining narrow until joining the ovate spermatheca. The free oviduct joins the short vagina just above the spermatheca.

The central teeth of the radula (Figure 8, center row) are tricuspid, 12–13  $\mu\text{m}$  wide and 15–16  $\mu\text{m}$  long, roughly the same shape as, but smaller than, the first lateral teeth, which are 16–17  $\mu\text{m}$  wide and 19–20  $\mu\text{m}$  long. The mesocones of both the centrals and first laterals are blade shaped, apically robust, widest slightly

above their mid-point, and narrowing basally, joining the rectangular basal plates close to, but not on, their posterior edge. The mesocones of the central teeth do not project beyond the anterior edge of the basal plates, those of the lateral teeth project beyond the edge. The ectocones are trigonal and short only 0.30 of the height of the mesocones, joining the posterior edge of the basal plates. The lateral teeth are barely asymmetrical, their endocones are only slightly taller than their ectocones. The endocones of the lateral teeth are slightly larger but otherwise of similar shape to their ectocones. The first ten teeth to the left and right of the central row are similar to the first laterals, the next four teeth on either side grade in shape and are difficult to classify as either laterals or marginals. The last five are clearly marginal teeth and are dorsoventrally compressed and tricuspid, 11–12  $\mu\text{m}$  wide and 12–18  $\mu\text{m}$  long (Figure 9). The endocones of the marginal teeth are 0.70 to nearly the same height as the mesocones and the ectocones vary from less than 0.50 to nearly 0.70 the height of the mesocones. The endocones and mesocones of the marginal teeth occasionally bear small notches or cusps near their apices.

**Lectotype:** SMF 137274.

**Paralectotype:** SMF 165564 (1 specimen).

**Remarks:** Möllendorff's description of *Paryphanta louisadarum* included a single set of measurements: major diameter 9.5 mm, minor diameter 6.5 mm, and altitude 6 mm. However, these measurements are difficult to match to either of the two now slightly broken shells of *P. louisadarum* donated from his collection to Natur-Museum Senckenberg, Frankfurt, and originally cataloged together as SMF 137274. One specimen has pattern of missing periostracum similar to the shell figured by Möllendorff and Kobelt (1902–1905). Labeling with this shell indicates it was separated from the other specimen and marked "Lectotype" based on its similarity to the shell figured by Möllendorff; later, Solem (1970) formally published this lectotype designation. The other specimen in the lot, now the paralectotype, was recatalogued as SMF 165564. Möllendorff's specimens of *Paryphanta louisadarum* came from Strubell, who also

**Table 1.** Measurements in mm of undamaged adult shells of four species of *Paryphantopsis*, N = sample size, H = height, D = diameter, SH = spire height, SD = spire diameter, AH = aperture height, AD = aperture width, W = number of whorls.

Species	N		H	D	SH	SD	AH	AD	W
<i>P. louisadarum</i>	50	Mean $\pm$ SD	7.5 $\pm$ 0.7	10.3 $\pm$ 0.7	0.1 $\pm$ 0.1	3.6 $\pm$ 0.3	6.2 $\pm$ 0.4	6.6 $\pm$ 0.5	2.8 $\pm$ 0.1
		Range	6.7–9.0	9.3–11.9	0.0–0.2	3.0–4.0	5.7–6.9	5.8–7.6	2.7–3.0
<i>P. misimensis</i>	11	Mean $\pm$ SD	6.0 $\pm$ 0.3	8.0 $\pm$ 0.5	0.1 $\pm$ 0.1	2.6 $\pm$ 0.2	5.1 $\pm$ 0.3	5.3 $\pm$ 0.2	2.5 $\pm$ 0.1
		Range	5.7–6.6	7.2–8.7	0.0–0.3	2.3–3.1	4.7–5.5	4.8–5.5	2.3–2.7
<i>P. vanatinensis</i>	50	Mean $\pm$ SD	5.8 $\pm$ 0.5	7.9 $\pm$ 0.7	0.1 $\pm$ 0.1	2.8 $\pm$ 0.3	4.9 $\pm$ 0.4	4.9 $\pm$ 0.6	2.6 $\pm$ 0.2
		Range	5.1–6.9	7.0–9.6	0.0–0.3	2.5–3.6	4.4–6.0	3.9–6.0	2.4–2.9
<i>P. yclensis</i>	10	Mean $\pm$ SD	2.7 $\pm$ 0.3	3.9 $\pm$ 0.3	0.1 $\pm$ 0.1	1.6 $\pm$ 0.2	1.9 $\pm$ 0.2	2.4 $\pm$ 0.1	2.8 $\pm$ 0.1
		Range	2.4–3.1	3.6–4.5	0.0–0.2	1.3–1.9	1.6–2.1	2.3–2.6	2.7–3.0

sent specimens to Fulton. These specimens were distributed to other collections that eventually found their way into museums, and are the source of UMMZ 127616 and ANSP 109257.

**Type Locality:** Louisiaden (Louisiade Archipelago).

**Other Material Examined:** Papua New Guinea, Milne Bay Province, Louisiade Islands, UMMZ 127616 (1 specimen); Rossel Island: ANSP 109257 (1 specimen); UF 339009 (27 specimens), base of Taclu Gap, 569 meters altitude, 11.353° S, 154.223° E, J. Slapcinsky, 5 May 2004; UF 339012 (15 specimens) PNGNM 005-001 (5 specimens), Lipuwopu at Lipu River, 320 meters altitude, 11.346° S, 154.221° E, J. Slapcinsky, 12 May 2004; BPBM 268733 (5 specimens), MNHW MN 998 (5 specimens), UF 339011 (16 specimens), UF 353425 (1 specimen), UF 353426 (1 specimen), Lubwe Creek at base of Taclu Gap, 638 meters altitude, 11.354° S, 154.223° E, J. Slapcinsky, 6 May 2004; UF 339015 (29 specimens), Taclu Gap below summit of Mount Rossel, 679 meters altitude, 11.356° S, 154.243° E, J. Slapcinsky, 4 May 2004; UF 339010 (4 specimens), W of former site of Gobubop Village, 285 meters altitude, 11.336° S, 154.221° E, J. Slapcinsky, 16 May 2004; UF 339013 (8 specimens), Wopu River upstream of trail crossing near abandoned Yela Village, 280 meters altitude, 11.338° S, 154.224° E, J. Slapcinsky, 14 May 2004; SFM (5 specimens), QM MO76144 (5 specimens), UF 339014 (12 specimens), Yelebop Mountain S of Mount Rossel, 777 meters altitude, 11.357° S, 154.222° E, J. Slapcinsky, 8 May 2004.

**Habitat:** Observed above 280 meters altitude in mixed hill forest and mixed lower montane forest, active during the day crawling on trees and shrubs from near ground level to 2 m height.

**Remarks:** Within *Paryphantopsis*, *P. louisadarum* is similar only to *P. globosa*, *P. misimensis*, *P. ubuwamensis*, and *P. vanatinensis* in lacking all traces of periostracal extensions on the growth lines. *Paryphantopsis louisadarum* differs from *P. globosa* in being smaller, having a closed umbilicus and fewer whorls and differs from *P. misimensis* and *P. vanatinensis* in having a penis that is robust apically and narrow basally. It further differs in body color pattern with two broad lateral bands not present in *P. misimensis* that extend to the sole of the foot unlike those of *P. vanatinensis*. The shell of *P. louisadarum* is usually irregularly maculated with darker pigment unlike the more uniformly colored *P. misimensis* and *P. vanatinensis*. *Paryphantopsis ubuwamensis* differs from *P. louisadarum* in having a more tightly coiled shell with a higher spire and an apical diverticulum on the epiphallus.

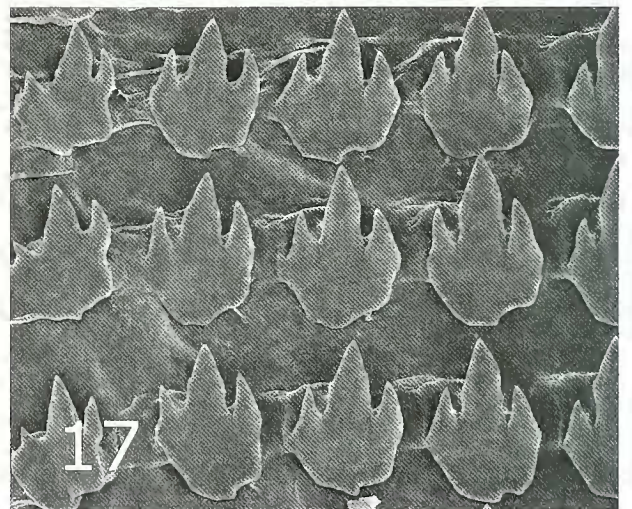
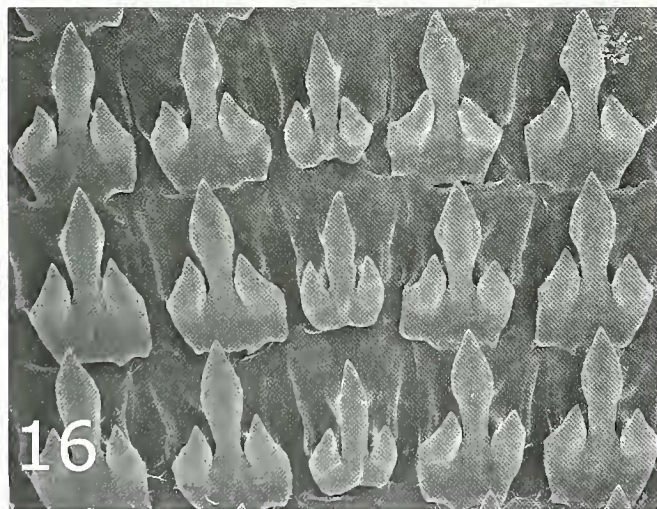
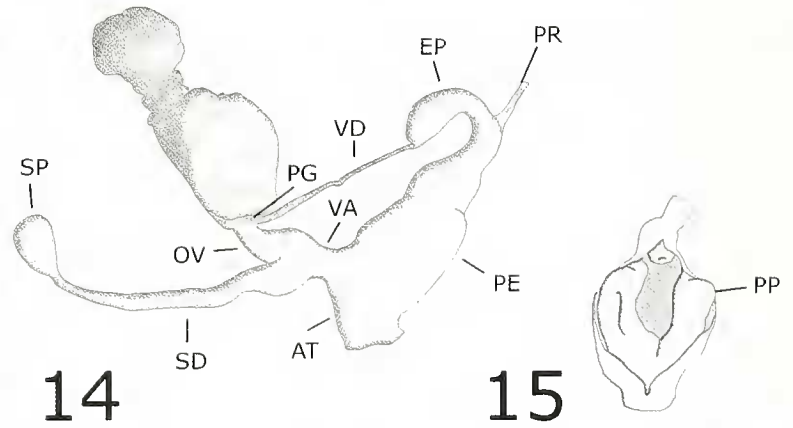
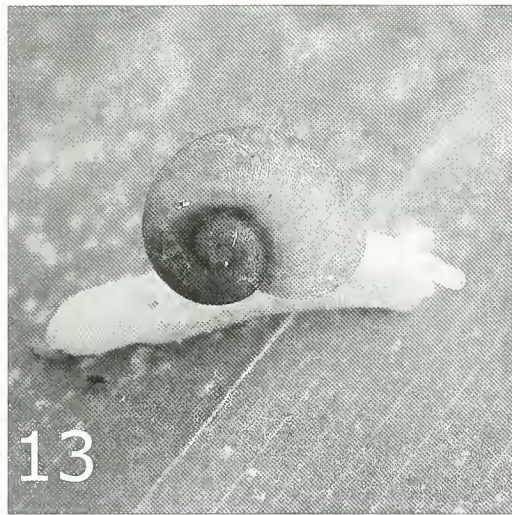
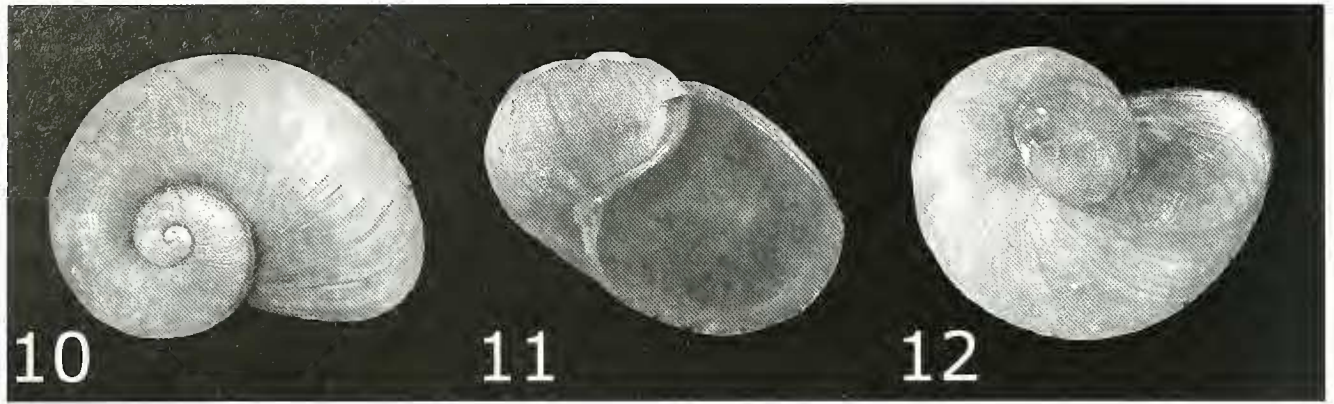
*Paryphantopsis misimensis* new species  
(Figures 10–17, Table 1)

**Description:** The adult shell is globose, large for the genus, 7.2–8.7 mm (mean = 8.0, see Table 1 for sample size and standard deviation) in diameter and 5.7–6.6 mm (mean = 6.0) in height, with 2.3–2.7 (mean = 2.5) rapidly

expanding whorls (Figures 10–12). The suture is deeply impressed and the shell margin is evenly rounded. The spire is flat to slightly elevated, 0.0–0.3 mm (mean = 0.1), the body whorl descends slowly and regularly. Shell height/diameter ratio is 0.68–0.81 (mean = 0.75). There are 1.3 evenly rounded protoconch whorls, sculptured with spiral rows of small pits; approximately 13 rows can be seen on the apex of adult shells. Rows of spiral pits are continued on the teleoconch, becoming weaker and eventually merging to become incised spiral striae. Spiral striae weaken becoming nearly obsolete on the final 0.25 of the body whorl where shell sculpture becomes predominated by weak and somewhat rounded growth lines that do not bear periostracal extensions. The protoconch and teleoconch whorls are uniformly brown, except for some darker pigmentation in the suture. The umbilicus is closed by a reflection of the peristome. The aperture is large, ovate, with an aperture-width to aperture-height ratio of 0.87–1.02 (mean = 0.97).

The body color is uniform yellow that fades to cream in specimens preserved in ethanol; there are no lateral bands on the foot or pigment on the eyestalks (Figure 13). The vas deferens narrows rapidly after the prostate gland and remains narrow until entering the slightly swollen head of the epiphallus (Figure 14). The epiphallus is robust, especially basally where it is twice the diameter of its mid-point, it does not bear a diverticulum, and is 1.25 times penis length. The penial retractor muscle originates on the diaphragm and is inserted near the mid-point of the epiphallus. The penis is robust throughout its length, approximately 0.25–0.30 larger than the base of the epiphallus. Penis is sculptured with two massive smooth pilasters (Figure 15). The spermatheca is ovate, its duct is narrow throughout its length expanding only slightly at the junction with the free oviduct at the short vagina only slightly above the atrium.

The central teeth of the radula (center row) are tricuspid, 9–10 µm wide and 16–17 µm long, smaller than the first lateral teeth, which are 13–14 µm wide, 21–22 µm long (Figure 16). The mesocones of the central teeth do not project beyond the basal plate while those of the lateral teeth do. The ectocones of the central and lateral teeth are about 0.30 the height of the mesocones. The laterals are tricuspid and slightly asymmetric with the endocone of each lateral tooth slightly taller than the ectocone. The endocones of the lateral teeth are slightly larger but otherwise of similar shape to their ectocones and both point towards their mesocones. The first seven teeth to the left and right of the central row are similar to the first lateral teeth, the next five teeth on either side grade in shape and are difficult to classify as either lateral or marginal teeth. The last six are clearly marginal teeth and are dorsoventrally compressed and tricuspid, without accessory cusps, 11–12 µm wide and 15–18 µm long (Figure 17). The endocones of the marginals are 0.70 the height of the mesocones while the ectocones are shorter, only 0.50 the height.



**Figures 10–17.** *Paryphantopsis misimensis*. 10–12. Photographs of shell, Holotype UF 308234, diameter 8.4 mm. 13. Photograph of live animal. 14–15. camera lucida drawing of genitalia, UF 353422, maximum width 9.3 mm. 16–17. Scanning electron micrograph of radula, UF 353422, field width of central and lateral teeth 73  $\mu\text{m}$ , marginal teeth 64  $\mu\text{m}$ .

**Holotype:** UF 308234, F. Kraus, 17 January 2003.

**Paratypes:** BPBM 268734 (2 specimens), PNGNM 005-002 (5 specimens), UF 303579 (19 specimens), UF 303580 (7 specimens), UF 353424 (1 specimen), UF 353422 (2 specimens), type locality, F. Kraus, 17 January 2003.

**Type Locality:** Papua New Guinea, Milne Bay Province, Louisiade Archipelago, Misima Island, Oya Tau, 1014 meters altitude, 10.660° S, 152.629° E.

**Habitat:** Active during the day on trees and shrubs within 2 meters of the ground in mixed lower montane forest near the summit of Oya Tau.

**Etymology:** Named for Misima Island where this species is presumed to be endemic.

**Remarks:** *Paryphantopsis misimensis* is similar only to *P. globosa*, *P. louisadarum*, *P. ubwamensis*, and *P. vanatinensis* in lacking all traces of periostracal extensions on the growth lines. *Paryphantopsis misimensis* differs from *P. globosa* in being smaller, having a closed umbilicus and fewer whorls and differs from *P. louisadarum* and *P. vanatinensis* in having a penis that is robust throughout its length, not having dark lateral bands on the foot, and having narrower radular teeth with endocones and ectocones that point towards the mesocones. *Paryphantopsis ubwamensis* differs from *P. misimensis* in having a more tightly coiled shell with a higher spire and an apical diverticulum on the epiphallus.

*Paryphantopsis vanatinensis* new species  
(Figures 18–25, Table 1)

**Description:** The adult shell is globose, larger than average for the genus, 7.0–9.6 mm (mean = 7.9, see Table 1 for sample size and standard deviation) in diameter and 5.1–6.9 mm (mean = 5.8) in height, with 2.4–2.9 (mean = 2.6) rapidly expanding whorls (Figures 18–20). The suture is deeply impressed and the shell margin is evenly rounded. The spire is flat to slightly elevated, 0.0–0.3 mm (mean = 0.1). Teleoconch whorls descend slowly and regularly until the final 0.70 of the body whorl where it descends more rapidly. Shell height/diameter ratio is 0.77–0.91 (mean = 0.85). There are 1.3 evenly rounded protoconch whorls sculptured with spiral rows of small pits; approximately 13 rows can be seen on the apex of adult shells. These pits become larger and less regular on the teleoconch whorls eventually fusing to form incised spiral striae. Spiral striae weaken slightly on the final 0.25 of the body whorl where shell sculpture becomes predominated by weak and somewhat rounded growth lines that do not bear periostracal extensions. Protoconch and teleoconch whorls are uniformly brown except for some darker pigmentation near the aperture. The umbilicus is closed by a reflection of the peristome. The aperture is large, ovate, with an aperture-width to aperture-height ratio of 0.92–1.12 (mean = 1.01).

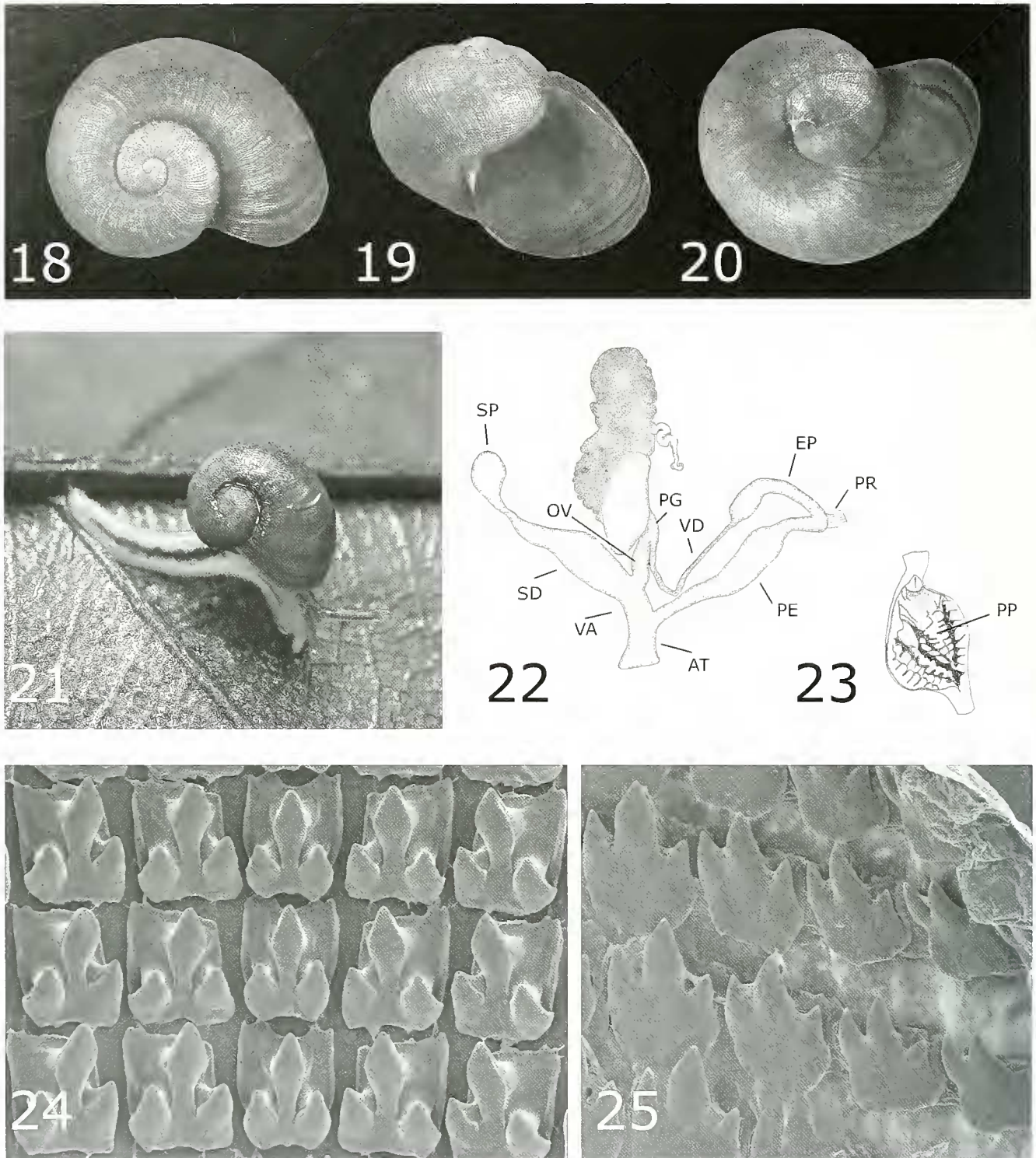
The body color is bright yellow with green-black pigment on the evestalks and in two weak mid-lateral bands on the anterior of the foot and two stronger mid-lateral

bands on the posterior half of the foot (Figure 21). These bands are solid, not maculate, do not extend to the ventral edge of the foot, and can not be seen on the sole of the foot. In some individuals the anterior bands are lacking. The yellow fades to creamy-white in specimens preserved in ethanol. The vas deferens narrows slightly to the junction with slightly inflated cylindrical head of the epiphallus (Figure 22). The epiphallus is approximately 0.50 the diameter of the penis, narrows only slightly basally and does not bear a diverticulum. The penial retractor muscle is short, originating from the diaphragm, and inserted at the basal 0.30 of the epiphallus. The penis is about the same length as the epiphallus, and sculptured with several rows of regularly plicate pilasters (Figure 23). The atrium is moderate in size and of consistent width. The spermathecal duct is robust remaining wide for basal 0.50 then tapering gradually to the junction with the ovate spermatheca. The free oviduct is about 0.50 the diameter of the spermathecal duct where they join. The vagina is of moderate length about the same length as the atrium.

The central teeth of the radula (middle row) are symmetrically tricuspid, 13–14  $\mu\text{m}$  wide and 17–18  $\mu\text{m}$  long. The slightly asymmetrical lateral teeth are otherwise similar in shape to the central teeth but are slightly wider, 15–16  $\mu\text{m}$  wide, and nearly identical in length, 17–18  $\mu\text{m}$  long (Figure 24). The bluntly conical and erect mesocones of the central and lateral rows join their basal plates near the posterior edge and project to or slightly beyond the anterior of their basal plates. The ectocones of both the central and lateral rows are trigonal and short, about 0.50 of the height of the mesocones, and join the posterior edge of their basal plates. The endocones of the lateral teeth are slightly larger but otherwise of similar shape to their ectocones. The first ten teeth to the left and right of the central row are clearly lateral teeth; the next five on either side grade in shape and are difficult to classify as either laterals or marginal teeth. The last five are clearly marginal teeth and are dorsoventrally compressed, tricuspid, about 11–14  $\mu\text{m}$  wide and 13–19  $\mu\text{m}$  long (Figure 25). The endocones are a bit more than 0.70 the heights of the mesocones while the ectocones are slightly shorter, about 0.70 the height of the mesocones.

**Holotype:** UF 353421, J. Slapcinsky, 19 April 2004.

**Paratypes:** Papua New Guinea, Milne Bay Province, Louisiade Archipelago, Sudest Island (Vanatinai, Tagula): BPBM 268735 (10 specimens), MNHW MP 959 (5 specimens), PNGNM 005-003 (10 specimens), SFM (10 specimens), QM MO76145 (5 specimens), UF 339019 (68 specimens), UF 347729 (3 specimens), UF 353420 (1 specimen), UF 353423 (1 specimen), type locality, J. Slapcinsky, 19 April 2004; UF 339018 (41 specimens), base of Mount Riu (Mount Rio) on the Esiraba River, 120 meters altitude, 11.492° S, 153.413° E, J. Slapcinsky, 15 April 2004; UF 339017 (37 specimens), near Avarumolo Rock Shelter, 150 meters altitude, 11.490° S, 153.420° E, J. Slapcinsky, 23 April 2004.



**Figures 18–25.** *Paryphautopsis vanatinensis*. **18–20.** Photographs of shell, Holotype UF 353421, diameter 7.6 mm. **21.** Photograph of live animal. **22–23.** Camera lucida drawing of genitalia, UF 353423, maximum width 5.9 mm. **24–25.** Scanning electron micrograph of radula, UF 353423, field width of central and lateral teeth 87  $\mu\text{m}$ , marginals 52  $\mu\text{m}$ .

**Type Locality:** Papua New Guinea, Milne Bay Province, Louisiade Archipelago, Sudest Island (Vanatinai, Tagula). Emua Peak, just W of the summit of Mount Rin (Mount Rio), 725 meters altitude, 11.507° S, 153.431° E.

**Habitat:** Found active during the day on trees and shrubs from near ground level to 2 meters in mixed hill forest and mixed lower montane forest from 120 meters to 725 meters altitude.



**Etymology:** Named for Vanatinai Island where this species is presumed to be endemic.

**Remarks:** *Paryphantopsis vanatinensis* is similar only to *P. globosa*, *P. louisadarum*, *P. misimensis*, and *P. ubuwamensis* in lacking all traces of periostracal extensions on the growth lines. *Paryphantopsis vanatinensis* differs from *P. globosa* in being smaller, having a closed umbilicus and fewer whorls and differs from *P. louisadarum* and *P. misimensis* in having a penis that is relatively narrow throughout its length and having dark lateral bands that are not maculate and do not extend to the sole of the foot. *Paryphantopsis ubuwamensis* differs from *P. vanatinensis* in having a more tightly coiled shell with a higher spire and an apical diverticulum on the epiphallus.

*Paryphantopsis yclensis* new species  
(Figures 26–32, Table 1)

**Description:** The adult shell is globose to depressed globose, small for the genus, 3.6–4.5 mm (mean = 3.9, see Table 1 for sample size and standard deviation) in diameter and 2.4–3.1 mm (mean = 2.7) in height, with 2.7–3.0 (mean = 2.7) rapidly expanding whorls (Figures 26–28). The shell is wider and slightly angular below the mid-point and its suture is deep, sometimes appearing nearly adnate. The spire is flat to elevated, 0.0–0.2 mm (mean = 0.1). Teleoconch whorls descend regularly and shell height/diameter ratio is 0.62–0.73 (mean = 0.68). There are 1.2 rounded protoconch whorls; approximately 13 rows of spiral lirae can be seen on the apex of adult shells. These lirae are crossed by stronger sharp axial lines forming a lattice pattern. The teleoconch is sculptured with spiral rows of pits that become less regular malleations on the final third of the body whorl. This shell sculpture is somewhat obscured by periostracal extensions approximately every 6–7 growth lines that are accentuated with processes at the angled shell margin. These processes are often worn and can be missing from some adult shells. The protoconch and teleoconch whorls are uniformly brown. A reflection of the peristome closes or nearly closes the umbilicus. The aperture is large, nearly circular except at the angled periphery and has an aperture-width to aperture-height ratio of 0.69–0.93 (mean = 0.80).

In life the body color is bright yellow, there are no lateral patches on the foot, the eyestalks are dark black-brown, the yellow fades to cream in specimens preserved in ethanol. The vas deferens narrows toward the junction with the inflated spherical head of the epiphallus. Immediately below the head of the epiphallus there is a finger shaped apical diverticulum that is roughly  $\frac{1}{2}$  the length of and nearly the same diameter as the epiphallus (Figure 29). The epiphallus is approximately the same length as the penis. The penial retractor muscle is long, originating from the diaphragm, and inserted just below the mid point of the epiphallus. The epiphallus is roughly half the diameter of the penis. The penis is widest 0.30 of the way down from the apex and narrows slightly towards

the apex and towards the base where it is 0.70 the diameter of the atrium at their junction. Penis sculptured with a narrow pilaster that widens basally (Figure 30). The atrium is average to short, about 0.50 the length of the relatively long vagina. The spermathecal duct, free oviduct, and vagina are all of similar diameter at their junction. The spermathecal duct is relatively narrow basally and tapers slowly and evenly until joining the spherical spermatheca.

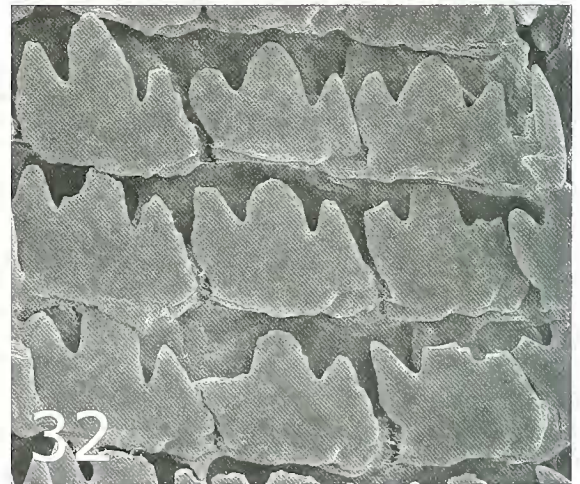
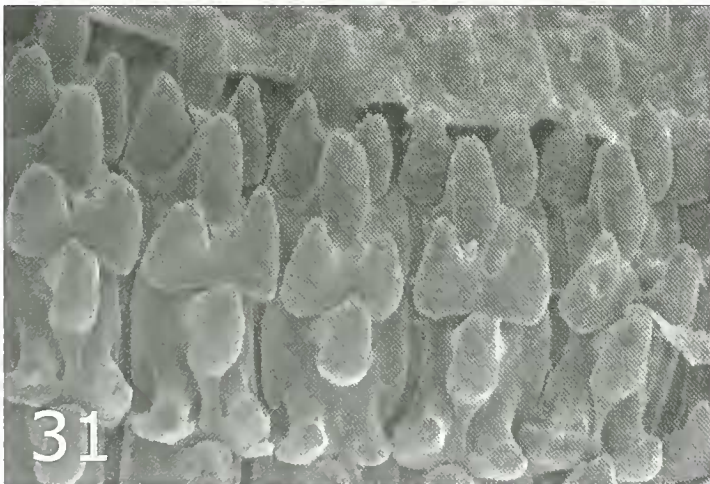
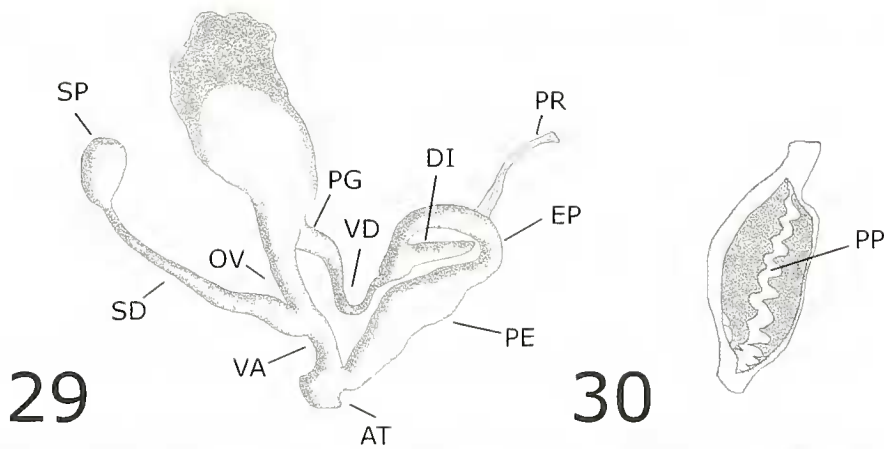
The central teeth of the radula (center row) are tricuspid, 7–8  $\mu\text{m}$  wide and 12–13  $\mu\text{m}$  long, of similar shape and length but slightly narrower than the first lateral teeth, 8–9  $\mu\text{m}$  wide and 12–13  $\mu\text{m}$  long (Figure 31). The mesocones of both the central and first lateral teeth are relatively short and blunt, not tapering until the rounded tip of the cusp and not extending beyond their basal plates. They appear particularly short because they project nearly perpendicularly from their basal plates and not as much anteriorly. Mesocones of the central and lateral teeth are attached toward the middle of their basal plates. The ectocones of the central teeth and the nearly symmetric ectocones and endocones of the laterals are trigonal and about 0.50 the height of the mesocones. The endocones of the lateral teeth are slightly larger but otherwise of similar shape to their ectocones. The first five teeth to the left and right of the central row are similar to the first lateral teeth, the next three on either side grade in shape and are difficult to classify as either laterals or marginal teeth. The last five are clearly marginal teeth and are dorsoventrally compressed and tricuspid, 7–9  $\mu\text{m}$  wide and 7–8  $\mu\text{m}$  long (Figure 32). The ectocones of the marginal teeth are only slightly shorter than their endocones, which are only slightly shorter than their mesocones.

**Holotype:** UF 353427, J. Slapcinsky, 12 May 2004.

**Paratypes:** Papua New Guinea, Milne Bay Province, Louisiade Archipelago, Yela Island (Rossel Island): UF 339016 (15 specimens), UF 353428 (1 specimen), type locality, J. Slapcinsky, 12 May 2004; UF 339120 (1 specimen), Wopu River upstream of trail crossing near abandoned Yela Village, 280 meters altitude, 11.338° S, 154.224° E, J. Slapcinsky, 14 May 2004; UF 339119 (1 specimen), former site of Gopubop Village, 275 meters altitude, 11.335° S, 154.222° E, J. Slapcinsky, 13 May 2004; UF 342911 (2 specimens), W of former site of Gopubop Village, 285 meters altitude, 11.336° S, 154.221° E, J. Slapcinsky, 16 May 2004.

**Type Locality:** Papua New Guinea, Milne Bay Province, Louisiade Archipelago, Yela Island (Rossel Island), Lipuwopu at Lipu River, 320 meters altitude, 11.346° S, 154.221° E.

**Habitat:** All specimens were collected in mixed hill forest from 275 to 285 m altitude. Individuals were observed active during the day on boulders that were densely encrusted with algae, mosses and lichens, and, less commonly, on dead logs and twigs near the ground.



Figures 26–32. *Paryphantopsis yclensis*. 26–28. Photographs of shell. Holotype UF 353427, diameter 4.3 mm. 29–30. Camera lucida drawing of genitalia, UF 353428, maximum width 4.7 mm. 31–32. Scanning electron micrograph of radula, UF 353428, field width of central and lateral teeth 17  $\mu\text{m}$ , marginal teeth 27  $\mu\text{m}$ .

**Remarks:** *Paryphantopsis yclensis* differs from all other *Paryphantopsis* from the Louisiades, *P. louisiodarum*, *P. misimensis*, and *P. vanatinensis*, and from the lowland species from the mainland, *P. lebasii* and *P. yavii*, in having an apical diverticulum on the epiphallus.

*Paryphantopsis yclensis* differs from all other species of *Paryphantopsis* other than *P. globosa* and *P. striata* in having protoconch sculpture of axial and spiral lirae rather than spiral pits. However, *P. globosa* and *P. striata* have roughly equal axial and spiral lirae while *P. yclensis*

has stronger axial sculpture. Of the species for which the radular morphology is known, the origin of the mesocones from the center of the basal plate in the central and lateral teeth of *P. yelensis* is similar only to *P. lebasii* and *P. yawii*.

**Etymology:** Named for Yela Island where this species is presumed to be endemic.

## DISCUSSION AND CONCLUSIONS

New Guinea lies at the leading edge of the Australian plate and is geologically complex, with much of the eastern and northern edge of the island and nearby satellite islands being composed of accreted terranes (Pigram and Davies, 1957). This complex geology has promoted the development of a unique and diverse biota that is still being discovered. Terrestrial invertebrates including snails are especially poorly known, being both inadequately sampled and diverse as evidenced by recent collecting in eastern Papua New Guinea. Recent collecting has uncovered high diversity and endemism in the genus *Paryphantaopsis*, with all isolated mountains sampled having unique suites of endemic and previously undescribed species (Slapcinsky, 2005).

The islands off New Guinea including the Louisiades are also rich in endemic *Paryphantaopsis* species, although only one of these, *P. louisadarum*, was previously described (Möllendorff, 1899) and later localized to Rossel Island (Solem, 1958) where it appears to be endemic. The Louisiades are also very poorly sampled with only approximately 30 species of terrestrial snails previously known from the archipelago (Iredale, 1941). The ongoing brief surveys of a small portion of the three largest islands in the Louisiade Archipelago have increased the known diversity of *Paryphantaopsis* in the Louisiades by 300%. In addition to *Paryphantaopsis*, species from several other charopid genera and other families were also collected; these will be treated in later publications. The family Charopidae, previously considered to be a minor component of the terrestrial mollusk fauna of New Guinea, with relatively few species and genera (Solem, 1953), may be among the most diverse families on New Guinea and its satellite islands, rivaling the spectacular radiations exhibited by this family in the oceanic Pacific (Solem, 1953).

Two groups of *Paryphantaopsis* appear to have colonized the Louisiade Archipelago. One group, *P. louisadarum*, *P. misimensis*, and *P. vanatinensis* share similar large, globose shells that have nearly flat spires and large apertures, are sculptured with spiral rows of pits that fuse to form incised spiral striae, and do not bear periostracal extensions or processes on the growth lines. A second group includes only *P. yelensis* a small species with strong axial sculpture on the protoconch and periostracal extensions with marginal processes on the growth lines of the teleoconch and with an apical diverticulum on the epiphallus. The relationship of both Louisiade clades

with species from mainland Papua New Guinea is not clear. The three large species from the Louisiades, *P. louisadarum*, *P. misimensis*, and *P. vanatinensis* lack periostracal extensions on the growth lines similar only to *P. globosa* and *P. ulwamensis* from mainland Papua New Guinea; however, they also lack an apical diverticulum similar only to *P. lebasii* and *P. yawii* from the adjacent Papuan Peninsula. The relationship of *P. yelensis* to mainland species of *Paryphantaopsis* is equally cryptic. The radula in this species has central and lateral teeth with mesocones that originate from near the center of the basal plates, a trait that is thus far known only from *P. lebasii* and *P. yawii*, however unlike those species, *P. yelensis* possesses an apical diverticulum. Although anatomic evidence suggests two origins for *Paryphantaopsis* in the Louisiade Archipelago, additional anatomic and/or genetic characters would be necessary to determine the relationships of these species to those from mainland New Guinea.

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